SECTION I.—AEROLOGY.

THE TWILIGHT COLORING OF 1913.

The years 1912 and 1913 were notable in the history of our globe for several violent volcanic eruptions of the explosive type. The eruption of Katmai in Alaska in 1912 and its attendant meteorological phenomena has already been treated in the Monthly Weather Review for 1913, volume 41, page 153, and in the Mount Weather Bulletin, volumes 5 and 6. The eruption of Asama-Yama, Japan, on June 17, 1913, and of Sakura-Shima on January 11–12, 1914, have not yet been discussed here. It is possible that we shall not be able to discriminate between the effects due to the one and to the other of these three eruptions. In the first of the following notes Prof. Ignazio Galli describes the noteworthy twilight colorings observed by him at Rome during 1913. These he ascribes to the dust cloud from the Asama-Yama eruption. The second note by Prof. Kimball presents observations at Mount Weather for the same period; but he is not yet prepared to assign the phenomena to any definite eruption.

ITALIAN TWILIGHTS OF 1913.[1]

By Prof. IGNAZIO GALLI.

[Dated Rome, Dec. 14, 1913.]

At 20h. 04m. [8:04 p. m.] July 13, 1913, I noticed that the northwestern sky was tinted a beautiful orange color with an extended base, later I saw the coloring increasing in intensity and becoming almost red toward the horizon. On the next day the same phenomena was repeated, but more weakly; on the evening of the 15th it returned with about the intensity that marked the glow of the 13th; and from the 16th to the 18th the intensity again diminished. On the evening of July 19, however, the atmospheric coloring at Rome was so splendid as to recall the celebrated twilights of the winter of 1883–84. On this date I wrote a letter published July 21–22, 1913, in the "Piccolo Giornale d'Italia," No. 202. For five months the phenomenon has continued with frequent variations in intensity, and only yesterday, December 13, it was very beautiful.

After July 19 the more vivid colorings appeared on the evenings of July 29, August 22, September 2, 5, 24, and 25, October 9 (through the clouds), and on November 29. On at least 24 other evenings the coloring was still very beautiful, a little later it was but moderate, and on occasions became weak or was almost absent.

In general, a few minutes after sunset the atmosphere about the horizon acquires a very strong white color which passes into a yellowish, and then into a decided yellow, into an orange hue, and finally turns to a more or less deep red. The yellow tint ordinarily begins 10 or 12 minutes after sunset, or a little earlier if the coloration is to become very beautiful.

The maximum height of 50 or 60 degrees, and sometimes even more, is almost always observed at the appearance of the yellow tint, with a horizontal extent of at least 90 degrees. The greatest height endures for a couple of minutes, sometimes even four or five minutes, after which the glow slowly (a rapid rate is rare) shrinks until there remains but a great red zone along the horizon. This belt gradually dissolves, and after a few minutes disappears. The slow variations in color make it impossible to ascertain the exact moments of their beginnings and endings. I may state, however, that the average duration of the whole phenomenon from the yellow to the extinction of the red, varies between 20 and 25 minutes, while the most beautiful appearances lasted from 30 to 35 minutes.

After the entire disappearance of the red light a large area of the western sky remains a bright whitish or a rose color for another 40 to 50 minutes. Not rarely the sky just above the red zone on the horizon takes on a green color clearly distinguishable from the dark blue of the remainder of the vault. It may be thought that the ocular impression of a green is only a physiological phenomenon due to the contrast with the red of the lower band, and in the greater number of cases this is probably the fact. But it is quite certain that sometimes the green color of the sky persists for 15, even 20, minutes after the entire disappearance of the red band. I have also observed this same phenomenon during other periods of vividly colored twilights.

. . . Although unfavorably situated since mid-October for observing the morning twilight, I have at times been in the open at about a half hour before sunrise, and I have always seen a more or less vivid rosy or orange coloring in the east, as might have been predicted. . . .

[1] Extracted and translated from a reprint of his paper in Atti, Pontif. acc. Romana dei Nuovi Lincei, anno 67, Dec. 14, 1913.

TWILIGHT COLORS AT MOUNT WEATHER, VA., IN 1913.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated Mount Weather, Va., Mar. 14, 1914.]

Early in August, 1913, the brilliancy of twilight colors both morning and evening attracted the attention of the observers at Mount Weather, Va. The colors reached a maximum brilliancy in September, but did not diminish noticeably until December. The following description of sunset colors for September 9, 1913, is characteristic of the twilight colors throughout this period:

Sun set about 6:30 p. m., seventy-fifth meridian time. The western horizon was then a brilliant orange, which increased in brilliancy until about 10 minutes after sunset, when a pink, or rose-colored glow appeared, extending from about 10° to 30° above the horizon, and for about 20° on each side of a vertical circle through the sun. This glow increased in brilliancy until about 20 minutes after sunset, and then gradually faded, disappearing about 30 minutes after sunset.

By this time the sky on the horizon for at least 60° on each side of the point of sunset was a brilliant red, shading off into bright yellow above, the latter color extending to a height of about 30°. At 7 p. m. the eastern sky was yellow, apparently on account of reflection from the western sky. The red on the western

horizon lasted until 7:30 p. m., when it was gradually replaced by yellow. The latter color was bright on the horizon until 7:40 p. m., and was barely visible at 7:50 p. m.—1 hour and 20 minutes after sunset. On some nights the twilight glow was visible for fully an hour and a half after sunset.

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RECENT BALLOON EXPERIMENTS.[1]

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Notwithstanding the satisfactory state of the theory of solar constant measurements by the method of Langley, depending upon spectro-bolometric observations at high and low sun combined with measurements by the pyrheliometer, and notwithstanding the close agreement between results obtained by this method for many years at stations of differing altitude from sea level to 4,420 meters elevation, there still exists the possibility that if we could, indeed, go outside the atmosphere altogether, we should obtain values differing materially from those given above. So long as we observe at the earth's surface, no matter how high the mountain top on which we stand, the atmosphere remains above us, and some estimate must be made of its transmission before the solar constant can be determined. Different persons will differ in the degree of confidence which they will ascribe to measurements of the atmospheric transmission such as have been considered, and there are still some who totally disbelieve in the accuracy of the results thus far obtained, even though they be confirmed by observations at such differing altitudes. Accordingly it has seemed highly desirable to check the results by a method of direct observation by the pyrheliometer, attaching the instrument for this purpose to a balloon and sending it to the very highest possible altitudes. By a coöperation between the Smithsonian Institution and the United States Weather Bureau, experiments for this purpose were made in July and August of the year 1913.

The instruments were modified in form from the silver disk pyrheliometer, which has been described above. As the apparatus could not be pointed at the sun, the disk was placed horizontally, and the thermometer was contrived to record its temperature by photography upon a moving drum. The receiving disk was alternately exposed to the sun and shaded by the intervention of a shutter, operated intermittently by the clockwork which rotated the drum under the stem of the thermometer. Five instruments of this kind were sent up on successive days. While it was well known that the temperature of the higher air would go as low as −55° C., it was believed that a blackened disk, exposed half the time to the direct sun rays, would certainly remain above the temperature of −40°, which is the freezing point of mercury. This expectation was disappointed. Accordingly, owing to the freezing of the mercury in the thermometer, the highest solar radiation records obtained during the expedition were at the altitude of 13,000 meters, although the balloons in some instances reached the altitude of 33,000 meters.

The results obtained, while they have not the same degree of accuracy as those obtained by direct reading of the silver disk pyrheliometer, are yet of considerable weight. All the measurements unite in indicating values of the solar radiation at altitudes of 10,000 meters and higher, which fall below the value of the solar constant of radiation as obtained by other methods, and above the value of the radiation at the summit of Mount Whitney as obtained by different observers with pyrheliometers. It is expected in the coming year to repeat the observations with balloons under much improved circumstances. By aid of electrical heating apparatus it is expected to keep the surroundings of the disks at approximately the freezing temperature, even though exposed to the air at temperatures as low as −55° C. In this way it is hoped to obtain good pyrheliometer measurements as high as it is possible for sounding balloons to go, and possibly to an altitude of 40,000 meters. As the atmospheric pressure at such altitudes is less than 1 per cent of that prevailing at sea level, the experiments, if successful, may be expected to remove reasonable doubt of the value of the solar constant of radiation.

[1] [Extracted from "The solar constant of radiation." Journal of the Washington Academy of Sciences, Washington, Mar. 4, 1914, v. 4, No. 5.]